

USDA
NATURAL RESOURCES
CONSERVATION SERVICE

DELAWARE CONSERVATION
PRACTICE STANDARD

DEEP TILLAGE

CODE 324
(Reported by Acre)

DEFINITION

Performing tillage operations below the normal tillage depth to modify adverse physical or chemical properties of a soil.

PURPOSES

This practice may be applied for one or more of the following purposes:

1. Fracture restrictive soil layers.
2. Bury or mix soil deposits from wind or water erosion or flood overwash.
3. Reduce concentration of soil contaminants, which inhibit plant growth.

CONDITIONS WHERE PRACTICE APPLIES

This practice applies to land having adverse soil conditions which inhibit plant growth, such as compacted layers formed by field operations, restrictive layers such as cemented hardpans (duripan) in the root zone, overwash or deposits from wind and water erosion or flooding, or contaminants in the root zone. This practice does not apply to normal tillage practices to prepare a seedbed.

This standard includes tillage operations commonly referred to as deep plowing, in-row subsoiling, strip-tillage, paratilling, subsoiling, ripping, or row-till, performed not as a part of the

normal tillage operations or at an altered depth.

CONSIDERATIONS

Where restrictive layers are a concern, the effects of this practice can be enhanced by including deep rooted crops in the rotation that are able to extend to and penetrate the restrictive layer.

Reduce or control equipment traffic during periods when soil is prone to compaction and formation of tillage pans. Caution should also be exercised when excessively heavy equipment is used. Loads greater than 6 tons/axle have been found to cause compaction to depths of approximately 16 inches which is below normal depths of tillage and may cause yield reductions for several years.

Reducing contact pressure between the load and the soil may also help to reduce compaction. Typical bias-ply tires require excessive inflation pressures which can concentrate the loads on the soil surface and cause excessive soil compaction. Radial tires reduce soil compaction and improve traction characteristics when properly inflated to the manufacturer's specifications. Other methods that can be used to further spread the load and potentially reduce soil compaction include using dual tires or tracts beneath tractors, grain wagons, slurry tanks, etc.

Research on numerous crops has shown that tillage conducted excessively deeper than the compacted layer does not promote increased yields, requires excessive amounts of tillage energy, and promotes future compaction from nearby vehicle traffic.

To help reduce compaction, it is desirable to conduct normal field operations when soil moisture is less than 50 percent of field capacity. Field harvest haul traffic should be limited to end rows or haul roads. Compacted regions between crop rows that are not fractured can assist in supporting vehicle traffic, limiting rutting and soil compaction beneath the row.

When infertile flood overwash is mixed with the pre-flood soil profile, the soil rebuilding process can be enhanced by addition of organic matter, such as manure or cover crops utilized as green

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manure. Crop rotations, tillage, and planting systems, which maintain high levels of crop residues, such as no-till, can also accelerate this process.

Where the flood overwash layer is too thick to effectively mix with the pre-flood soil profile, redistribution of the overwash layer by smoothing or removal may be necessary. Generally, no more than 6 inches of overwash can be uniformly mixed into the soil profile using commonly available equipment. Specialized equipment may be necessary where greater depths of overwash are to be incorporated.

Where unfavorable soil materials such as high sodium, calcium, gypsum, or other undesirable materials, are within anticipated deep tillage depth and would be brought to the surface by deep tillage operations, this practice should not be applied.

Transport of sediment-borne pollutants offsite can be reduced when this practice is used in a conservation management system by reducing the concentration of pollutants in the surface layer.

Moldboard plows and large tandem disks create conditions ideal for soil compaction to occur. Chisels with twisted points have a slightly less destructive impact.

Disruption of the soil surface is not desired and should be minimized where possible through proper selection of shanks. Excessive disturbance of the soil surface can cover plant residues which should be maintained on the soil surface to intercept rainfall and impede surface runoff.

CRITERIA

Criteria Applicable to All Purposes

Deep tillage operation shall be preformed when soil moisture is less than 30 percent of field capacity, according to the “feel test” or other acceptable methods, at the maximum depth to which the tillage will be done.

Additional Criteria to Fracture Restrictive Soil Layers

Use tillage equipment such as chisels, subsoilers, or rippers with the ability to reach the required depth to fracture the restrictive layer.

The depth of tillage shall be a minimum of one inch deeper than the depth of the restrictive layer. Tillage depth should be set carefully and periodically checked to maintain this working depth.

Complete fracturing of the restrictive layer is not required. The fractured zone, as a minimum, shall be sufficient to permit root penetration below the restrictive soil layer. The fractured zone does not need to extend to the middle of the rows and should be limited to the area near the rows. In the case of broadcast planted or plants drilled in narrow rows, the fractured zone may be disrupted completely.

Additional Criteria to Bury or Mix Soil Deposits from Wind and Water Erosion or Flood Overwash

To bury soil deposits from wind and water erosion or flood overwash, tillage equipment such as large disk plows and moldboard plows with the ability to reach the required depth shall be used.

To mix soil deposits from wind and water erosion or flood overwash, tillage equipment such as large chisels with twisted points, disc plows, and moldboard plows shall be used. Soil depositions shall be mixed a minimum of two times the depth of the soil deposit to achieve a desired available water-holding capacity and to break the hydraulic barrier caused by the soil deposit layer.

Additional Criteria to Reduce Concentration of Soil Contaminants Which Inhibit Plant Growth

The soil contaminant shall be uniformly distributed throughout the deep tilled layer.

Tillage equipment such as chisels with twisted points, disk plows, or moldboard plows with the ability to reach the required depth shall be used.

The tillage operation shall mix a sufficient amount of uncontaminated soil with the contaminated material so that the concentration of the contaminant is below the crop tolerance level. Crop tolerance levels shall be established in accordance with the Land Grant University guidance and recommendations.

PLANS AND SPECIFICATIONS

Plans and specifications for this practice shall be prepared in accordance with the previously listed criteria. Plans and specifications shall contain sufficient detail to ensure successful implementation of this practice. Documentation shall be in accordance with the section "Supporting Data and Documentation" in this standard.

OPERATION AND MAINTENANCE

An Operation and Management (O&M) plan shall be prepared and is the responsibility of the client to implement. Appropriate job sheets may serve as the management plan, as well as supporting documentation, and shall be reviewed with and provided to the client.

At a minimum, the following components shall be addressed in the O&M plan, as applicable:

1. When deep tillage has been performed for the reduction of soil compaction, monitor the root zone and plant condition to determine if treatment will need to be reapplied.
2. Deep tillage for reduction of soil compaction shall be performed in a timely period prior to planting the desired crop.

SUPPORTING DATA AND DOCUMENTATION

The following is a list of the minimum data and documentation to be documented in the cast file:

1. Location the practice on the conservation map;
2. Assistance notes. The notes shall include dates of site visits, name or initials of the person who made the visit, specifics as to alternatives discussed, decisions made, and by whom;
3. Soils map and soil interpretation of the managed site;
4. Note the depth of compaction and appropriate tillage tools to mitigate.

REFERENCES

1. Baumhardt, R.L., O.R. Jones, and R.C. Schwartz. 2008. Long-term effects of profile modifying deep plowing on soil properties and crop yield. *Soil Sci. Soc. Am. J.* 72:677-682.
2. Reeder, R. and D. Westermann. 2006. Soil management practices. p. 63. In M. Schnepf and C. Cox (ed.) *Environmental benefits of conservation on cropland: The status of our knowledge*. Soil and Water Conservation Society, Ankeny, IA.
3. USDA, NRCS. 1996. *Soil Quality Information Sheet: Sediment deposition on cropland*.